multiplicity of hydrogen gas detectors as in claim 30, each of which is arranged for exposure to a specific individual locus of the extended area region.

REMARKS

Response to Objection of Drawings Under 37 C.F.R. §1.83(a)

In the January 22, 2001 Office Action, the Examiner objected to the drawings under 37 C.F.R. §1.83(a) as failing to show every feature of the invention specified in the claims. Specifically, the Examiner stated that the following claimed features are omitted by the drawings:

(i) the output alarm;

(ii) the optical waveguide;

(iii) a plurality of light sources and detectors.

In response, applicants direct the Examiner's attention to the fact that The feature specified in (i), i.e., the output alarm, has been shown in Figures 1 and 2 as numeral 28. The specification refers, on page 21, lines 14-17, to "output module 28, which may provide a visual, audible, tactile or other alarm indicative of the presence of hydrogen in the gaseous environment being monitored". A person ordinarily skilled in the art will be able to appreciate that the output module 28 in Figures 1 and 2 represents an output alarm as claimed, and such representation satisfies the requirements under 37 C.F.R. §1.83(a).

It is noted that not all classes of inventions require drawings. For product or composition applications, there is a distinction between applications that require drawings to understand the subject matter of the invention, and applications in which the nature of the invention merely admits of an illustration by a drawing, without a drawing being necessary to understand the

subject matter claimed. The applicable test is whether the specification is sufficient to enable a person of ordinary skill in the art to make and use the apparatus without undue experimentation. *In re Scarbrough*, 500 F.2d 560, 182 USPQ 298 (CCPA 174).

The features specified in (ii) and (iii) are directed to specific embodiments of the claimed invention. The specification has already provided sufficient information for a person of ordinary skill in the art to make and use such specific features as claimed, without undue experimentation (see instant specification, page 30-31, and page 25-26). Additional drawings are therefore not necessary for purpose of understanding such claimed features under the provisions of 37 C.F.R. §1.83(a).

Applicants therefore respectfully request the Examiner to withdraw the above-specified objections to the drawings.

<u>Response to Rejections of Claims</u>

In the January 22, 2001 Office Action, the Examiner rejected claims 1-62 as being unpatentable over:

- Ito et al. U.S. Patent No. 5,775,016 (hereinafter "Ito") under 35 U.S.C. §102; and
- Ito in view of Griessen et al., "Yttrium and Lanthanum Hydride Films with Switchable Optical Properties", JOURNAL OF ALLOYS AND COMPOUNDS, vol. 253-254 (1997), pp. 44-50 (hereinafter "Griessen") under 35 U.S.C. §103.

The applicant hereby traverses such rejections, for the ensuing reasons.

<u>The Cited References, Either Taken Separately or in Combination, do not Teach or Suggest a Source of Thermal Energy for Heating the Rare Earth Metal Film</u>

Claims 1-62 of the present invention expressly require **<u>source(s) for both light and thermal energy</u>**.

Specifically, independent claims 1 and 21, from which claims 2-20 and 22-29 depend, recite "a light/heat source". The specification has defined such light/heat source as "any suitable **<u>source of both luminescent and thermal energy</u>**, either together or separately" (see instant specification, page 11, lines 20-21). Independent claim 30, upon which claims 31-45 depend, requires "**<u>a light source; [and] a thermal energy source</u>**". Method claim 46, upon which the remaining method claims 47-62 depend, recites "providing **<u>a source of luminous and thermal energy</u>**".

Thus the claim language in the present application unequivocally requires a source of thermal energy in concurrent existence with a source of light. Such thermal energy source functions to heat the rare earth metal thin film coating and therefore minimizes the "recovery" time necessary for the rare earth metal thin film (see the instant specification, at page 13, lines 4-9). The recovery time is the reaction time required for the following reaction:

$$2YH_3 \text{ (transparent)} \xrightarrow{\Delta} 2YH_2 \text{ (opaque)} + H_2$$

Without a thermal energy source, the hydrogen gas detector requires an undesirably long recovery period between subsequent hydrogen detection cycles, and during such recovery period, the hydrogen gas detector is basically in a "handicapped" state, unable to respond to hydrogen presence. Such long recovery period thus significantly limits the utility of the detector in a dynamic gas environment. The present invention provides a thermal energy source to reduce such recovery period.

Neither Ito nor Griessen teaches or suggests providing a thermal energy source.

On the contrary, both references **expressly teach away** from providing thermal energy or heating the hydrogen sensor.

Ito relates to a hydrogen gas sensor employing a solid compound that is reducible by hydrogen atoms, e.g., WO_3, MoO_3, TiO_2, $Ir(OH)_n$, V_2O_5, etc, whose photo absorption rate changes when reduced by hydrogen. Nothing in Ito suggests addition of a thermal energy source to heat the hydrogen sensor. In fact, Ito considers temperature fluctuations as having undesirable impacts upon the performance of the hydrogen sensor and specifically teaches that even fluctuation in ambient temperature will deleteriously change the photo absorption characteristics of the hydrogen sensor (see Ito, column 6, lines 51-56). Ito even provides a mechanism for compensating temperature fluctuation in the environment (see Ito, Figure 8, and column 6, lines 48-65).

It is obvious that Ito strives to minimize the impact of temperature fluctuations on the hydrogen sensor. Direct heating of the hydrogen sensor to increase temperature fluctuations is therefore inconsistent with the express teachings of Ito. A person ordinarily skilled in the art, after reading Ito, would not contemplate using a thermal energy source to directly heat the hydrogen sensor; contrariwise, such person would avoid the approach of applicants' claimed invention, since it flies in the face of Ito's teachings.

Additionally, Griessen does not teach or suggest provision of such a thermal energy source. Griessen discloses that yttrium and lanthanum films exhibit switchable optical properties in the presence of hydrogen gas. Specifically, Griessen recognizes the temperature dependence of the photoconductivity of such films (see Griessen, page 44, left column, middle section), and Griessen's experiments evidence a preference for operating at room temperature (see Griessen,

page 45, right column, bottom section; page 46, explanation to Figure 2, second line; and page 47, left column, middle section).

Therefore, neither Ito nor Griessen nor their combination contains any express, implied, or extrapolative basis for providing a thermal energy source in combination with a light source, as required in applicants' claims 1-62. The present invention therefore embodies a fundamental departure from the teachings of the cited art references.

The Use of An Incandescent Lamp or Light Bulb

Claims 15 and 29 require that the light/heat source "comprise[s] a lamp element **providing heat output incident to the generation of light**". Claims 16-17 and 22-24 specifically requires such lamp element to be an **incandescent lamp or light bulb**.

The Examiner, in the January 22, 2001 Office Action, conceded that Ito "does not teach that the light source could be an incandescent lamp, light bulb" but insisted that "it would have been obvious to one having ordinary skill in the art at the time the invention was made to replace the light source of Ito et al by a lamp because the device would function in the same manner whether the light source is a LED or a lamp" (see Office Action, page 5, first paragraph).

Based on the discussion hereinabove, it is clear that Ito requires a light source that causes minimum temperature fluctuation, such as LED. An incandescent lamp, which produces both light and heat, causes too much temperature fluctuation and is unsuitable for achieving the operational purpose of Ito.

Claims 15-17, 22-24, and 29 of the present application, in contrast, require a light source that produces heat output incident to the generation of light. An incandescent lamp is such a light source.

The Examiner has contended that a LED and an incandescent lamp function in the same manner. However, applicants strongly disagree. A LED is a "cold" light source, generating negligible thermal energy, while an incandescent lamp is a "hot" light source, which in use in applicants' claimed invention, generates thermal energy to the hydrogen sensor. A reasonable person would not find any suggestion or motivation in Ito to substitute an LED with an incandescent lamp, since such substitution is entirely contrary to the express teachings of Ito, and would frustrate the objective of Ito to avoid thermal perturbation of the hydrogen sensor.

Therefore, the subject matter of applicants' claimed invention is novel and non-obvious over the cited references.

CONCLUSION

In view of all the foregoing, claims 1-62 as amended herein are in form and condition for allowance. Issue of a Notice of Allowance therefore is respectfully requested.

No fee is due for the entry of this Amendment. Nevertheless, if any fee or charge is deemed properly payable, the United States Patent and Trademark Office hereby is authorized to charge any payment necessary to the entry of this Amendment, to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

If any issues remain outstanding, the Examiner is requested to contact the undersigned at (919) 419-9350 to discuss their resolution, and expedite closure of prosecution on the merits in favor of allowance of claims 1-62.

Respectfully submitted,

Yongzhi Yang
Registration No. (see attached)

Marianne Fuierer
Registration No. 39983
Attorneys for Applicants

**INTELLECTUAL PROPERTY/
TECHNOLOGY LAW**
P.O. Box 14329
Research Triangle Park, NC 27709
Phone: (919) 419-9350
Fax: (919) 419-9354
Attorney File No.: 2771-401 (7482)

APPENDIX A

Version with Markings to Show Changes Made

In the Claims:

1. (amended) A hydrogen gas detector for detection of hydrogen gas in a gaseous environment, said detector comprising a light/heat source, an optical detector, and an optical barrier therebetween, wherein the optical barrier is disposed in proximity to the light/heat source so that the optical barrier is simultaneously illuminated and heated by said light/heat source, wherein the optical barrier responds to the presence of hydrogen by responsively changing from a first optical state to a different second optical state, and whereby transmission of light from said light/heat source through said optical barrier is altered by the presence of hydrogen and said altered transmission is sensed by said optical detector to provide an indication of the presence of hydrogen gas in the gaseous environment.

9. (amended) The hydrogen gas detector of claim 7, wherein surface morphology roughness of the optical output surface of the light/heat source prior to deposition of the rare earth metal thin film has been increased by treatment of the optical output surface comprising a roughening step selected from the group consisting of mechanical roughening, chemical roughening, deposition of highly exfoliated or porous inorganic underlayers, and deposition of porous polymer underlayers, to thereby increase the response [time] speed of the rare earth metal thin film as compared with a corresponding unroughened optical output surface.

20. (amended) The hydrogen gas detector of claim 18, wherein said optical barrier comprises a multi-layer structure deposited on the optical output surface of said optical waveguide, said multi-layer structure comprising at least a first and a second layer, wherein the first layer absorbs optical energy of a first wavelength and transfers said optical energy of the first

wavelength into thermal energy, [is thereby heated] while remaining transparent or translucent to optical energy of a second wavelength, and wherein the second layer comprises a rare earth metal thin film, the optical properties of which are responsive to the presence and concentration of hydrogen gas in the surrounding environment.

21. (amended) A hydrogen gas detector for detection of hydrogen gas in a gaseous environment, said detector comprising a light/heat source, at least one optical detector, and at least one optical barrier deposed between the light/heat source and each detector in proximity to the light/heat source so that the optical barrier is simultaneously illuminated and heated by said light/heat source, wherein the optical barriers respond to the presence of hydrogen by responsively changing from a first optical state to a different second optical state, and whereby transmission of light from said light/heat source through said optical barriers is altered by the presence of hydrogen and said altered transmission is sensed by said optical detectors to provide an indication of the presence and concentration of hydrogen gas in the gaseous environment.

31. (amended) The hydrogen gas detector of claim 30, wherein the light source [of luminous energy] comprises a light-generating element selected from the group consisting of incandescent bulbs, light emitting diodes, fluorescent lamps, electroluminescent lamps, and optical lasers, and optical waveguides illuminated by any such light-generating element.

45. (amended) A hydrogen detection system for monitoring an extended or remote area region for the incursion or generation of hydrogen therein, said hydrogen detection system comprising a multiplicity of hydrogen gas [detector elements] detectors as in claim 30, each of which [(i)] is arranged for exposure to a specific individual locus of the extended area region [and (ii) employs an optical filter comprising a rare earth metal thin film that exhibits a detectable

change in optical transmissivity when the rare earth metal thin film is contacted with hydrogen at said locus].